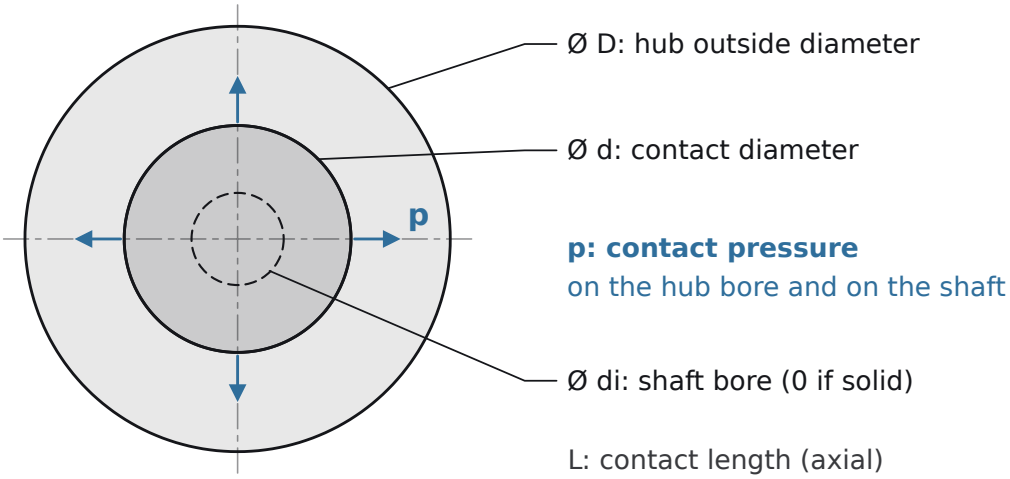
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Interference fit: Lamé equations, torque and shrink-fit heating

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1. Interference fit formulas



Quantity	Formula	Note
Contact pressure (general case)	$p = \delta / [\ d/E_h \cdot ((D^2 + d^2)/(D^2 - d^2) + \nu_h) + d/E_s \cdot ((d^2 + d_i^2)/(d^2 - d_i^2) - \nu_s)\ ]$	Two materials, solid or hollow shaft
Pressure, same material, solid shaft	$p = E \cdot \delta/(2d) \times (D^2 - d^2)/D^2$	ν drops out of the formula
Hub hoop stress at the bore	$\sigma_t = p \times (D^2 + d^2)/(D^2 - d^2)$	Tensile, maximum at the bore
Radial stress at the interface	$\sigma_r = -p$	Compressive, on both parts
Hub equivalent stress (von Mises)	$\sigma_{eq} = \sqrt{(\sigma_t^2 + \sigma_t \cdot p + p^2)}$	To compare with the hub's yield strength
Hollow shaft hoop stress at the interface	$\sigma_{t,s} = -p \times (d^2 + d_i^2)/(d^2 - d_i^2)$	Solid shaft: −p
Axial force capacity	$F = \mu \cdot p \cdot \pi \cdot d \cdot L$	Also the order of magnitude of the press-in force
Torque capacity	$T = F \cdot d/2 = \mu \cdot p \cdot \pi \cdot d^2 \cdot L / 2$	With the minimum interference
Hub heating for a shrink fit	$\Delta T = (\delta + j) / (\alpha_h \cdot d)$	j: clearance wanted at assembly

Units must be consistent: mm and MPa give p in MPa, F in N and T in N·mm (÷ 1,000 for N·m); inches and psi give p in psi, F in lbf and T in lbf·in. The interference δ is **diametral**: if you start from a radial interference, double it.

2. Metric and inch examples

Solid Ø 50 mm shaft, hub outside diameter 100 mm, contact length 50 mm, steel E = 210,000 MPa, ν = 0.3. H7/p6 fit: the bore is 0 / +25 µm and the shaft +26 / +42 µm (see the ISO 286 table), an interference of 1 to 42 µm.

Quantity	Calculation	Result
Contact pressure p	$210{,}000 \times 0.042 / (2 \times 50) \times (100^2 - 50^2)/100^2$	**66.2 MPa**

Quantity	Calculation	Result
Hub hoop stress σ_t	$66.2 \times (100^2 + 50^2)/(100^2 - 50^2)$	**110 MPa**
Hub equivalent stress	$\sqrt{(110^2 + 110 \times 66.2 + 66.2^2)}$	**154 MPa**
Axial force F	$0.1 \times 66.2 \times \pi \times 50 \times 50$	**52.0 kN**
Torque T	$51{,}954 \times 25$	**1,299 N·m**
Hub heating (assembly clearance 0.05 mm, $\alpha = 12 \times 10^{-6}$/K)	$(0.042 + 0.05) / (12 \times 10^{-6} \times 50)$	**153 K**

At the *minimum* interference of the same H7/p6 (1 µm), the pressure drops to 1.6 MPa and the guaranteed torque to only 31 N·m: a p6 fit is enough to locate a part, not to transmit a large torque. For that you need a tighter fit or a positive connection (key, splines).

Reference values taken from the article https://www.baouch.fr/en/blog/ajustement-serre-frettage-calcul/, which explains the assumptions, formulas and edge cases. For critical use, check the current standard or the manufacturer's documentation. Free to print and share with credit to the source.